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Prepared for: U.S. DOT Pipeline and Hazardous Materials Safety Administration

Project Title: Hybrid Laser/Gas Metal Arc Welding (GMAW) of High-Strength Steel Gas Transmission Pipelines

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Progress to Date: Despite significant investment, one-shot welding and power beam processes have failed to achieve real benefits in pipeline construction. New developments in Yb-Fiber lasers have changed the paradigm. Innovative Hybrid Laser/arc welding techniques which can complete 5G welds offer the best chance of developing high integrity welding processes. The innovative Hybrid Laser/Gas Metal Arc Welding (hybrid welding) process will be developed for application in mechanized welding of high-strength steel pipelines.

This project is being funded by the U.S. Department of Transportation's Pipeline and Hazardous Materials Safety Administration with an expanded project team. EWI will lead the effort in collaboration with CRC-Evans, ExxonMobil, Chevron, ConocoPhilips, Heerema Marine Constructors, Tenaris Tamsa, McDermott, POSCO, Lincoln Electric, and Acergy.

The major objectives of this program are to:

- Develop hybrid welding process and technologies for pipeline girth welding.
- Demonstrate such a system under field conditions.
- Develop techniques for variations of power (4-10kW) that have the greatest potential to meet existing pipeline integrity requirements.

EWI has worked with CRC-Evans to develop and build a laser-hybrid bug and band system. This system has been installed in the lab and integrated with EWI's laser power source. Hybrid Laser-GMAW welds were completed on simulated joints at travel speeds up to 120 IPM and laser powers up to 10kW. Full penetration welds are achievable with a 4mm root face.

Welding experiments have been performed on both X-80 and X-100 pipe materials at travel speeds up to 120 IPM. Mechanical tests have been completed on welds at differing welding speeds with preheat and a tempering second GMAW bead. High speed data acquisition was used to acquire current, voltage, and laser power during the hybrid process.